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(71)(72) Applicant and Inventor: DROZDOWSKI, Grzegorz [PL/PL]; ul. B. Głowackiego 55/84, PL–85–717 Bydgoszcz (PL).

(74) Agent: WOJCIESZKO, Jerzy; Kancelaria Patentowa Patent–Partner, ul. B. Rumińskiego 6, P.O. Box 62, PL–85–001 Bydgoszcz (PL).

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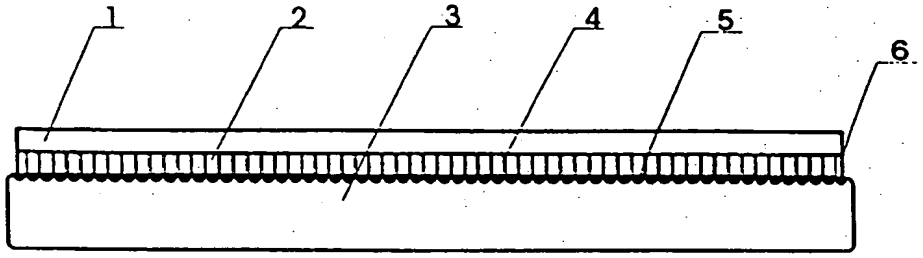
(54) Title: THE METHOD OF OPTICAL ANALYSIS OF IMAGE IN SCREENS FOR REAR PROJECTION AND THE SCREEN FOR THIS METHOD

(57) Abstract



The essence of the invention in range of the method, mainly consists in the fact that: the light image generated by the projector is projected on the rear surface of the screen, optical analysis takes place on its fore surface through transparent optical microelements due to which a contrastive image without a glare effect is obtained on the fore surface of the screen. However, as far as the screen structure is concerned, the essence of the invention consists in the fact that: to make an optical analysis of the image with rear projection the screen is made in the form of the panel made of transparent material of the structure which enables to obtain a contrastive image on the fore surface without a glare effect, and that in the panel of the screen (1) there are embedded optical microelements (2).

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The method of optical analysis of image in screens for rear projection and the screen for this method

The subject of the invention is the method of optical analysis of the image in screens for rear projection, as well as the screen for this procedure. The invention subject in the range of the method is assigned to apply it in screens used for rear projection in TV-sets and widescreen monitors, where no conventional picture tube is used. The invention subject can be also used in rear projection techniques where the glass or plastics focusing screens have been used so far. It also refers primarily to film cutting benches in the cinema and TV postproduction and professional slide viewers of larger screen format. The invention subject may also be designed whereever focusing screens are used and due to improvement of image quality, the focusing screens can be replaced.

An optical focusing screen has been an optical device used in technical appliances, mostly in TV sets with rear projection, where an image generated by the projector was projected on the rear surface of the screen made in shape of turbid panel. An image which did not cause any glare appeared on the surface of the screen.

The screens used to rear projection, e.g. in widescreen TV sets and monitors are made in form of large sized focusing screens, many a time modified in different manners.

An optical focusing screen used in large screens is generally made in form of a panel 3 to 8 mm thick from the plastics of a special selected visible light transmittance. Technical solutions of this type are used by most of the widescreen TV and multimedia appliances. Screens for rear projections made of plastics are used by such companies as: *Panasonic, Philips, Pioneer, Sony, Thomson.*

The most modern contemporary TV projectors using rear projection have the screens made of plastics, where designers applied optical elements which mostly use physical properties of Fresnel lens to obtain better angular parameters of watching image on the screen and to obtain lower light loss. The image attained in this way on the screen surface is in a sufficient contrast, brightness and sharpness.

However, comparing the image tube, all images which are rear projected on the screens and made of typical optical focusing screen or of the similar surface, do not give such a sharp and contrastive image as conventional image tube made in *Delta, Qiuntrix*, or *Trinitron* technology does. To improve visual parameters in the appliances for rear projection which have LCD-image converters, very strong light sources are used. The use of very strong light source in form of halogen lamp of a few hundred Watt of power significantly improve brightness of the obtained image, but does not really improve the contrast. However, in case of TV sets and multimedia monitors, the acquisition of accurate contrast on surface of a screen using optical focusing screen is very troublesome. Lack of accurate sharpness, contrast and brightness of image is a general cause of poor interest of the rear projection technology, especially in widescreen TV sets. Only the latest achievements of some companies have improved parameters of widescreen TV sets with rear projection, where three panels LCD-RGB of diagonal 1.35", resolution of 921.600 pixels/307.300 x 3 as image-generating elements have been used / it refers to *Sony* TV projector model VPL-V500Q . This new technology permitted for using similar parameters as in classic TV systems with the use of kinescopes. However, the application of the screens

using optical focusing screen and elements of Fresnel lens, even in so technologically advanced TV appliances, introduces quite large restrictions in creating image on the screen surface. The optical focusing screen introduces in its essence less sharp and contrast image than the image-tube, because it is not an optically transparent system. It appears that the image-tube is always better while comparing optical focusing screen and colour image-tube by projecting the same pictures.

The situation is similar with appliances for cinema production and viewers of larger size of the screen. In all those equipment the screens made in form of a glass or plastic focusing screen are used.

The light loss arising due to the use of optical focusing screens are on the average about 20 to 30 per cent. It is quite a significant problem, especially in the equipment where the design assumption is to obtain high contrast of the projected image.

The essence in the range of the method is based on the optical analysis of image, in the screens for rear projection where the light image generated by the projector is projected on the rear surface of the screen, whereas the optical analysis of the image takes place on its forward surface and at the same time the light is going through the transparent material of the screen panel which structure enables to obtain the contrasted image on the forward surface without any glare effect and the generated light goes through the transparent optical microelements which are set in the screen panel best with the form of cylindrical cross section, and which are located in such a manner that their longitudinal axes are perpendicular to both surfaces of the screen and at the same time their length and number are selected relating to the power of the light source and the required screen resolution and contrast. Their cross sectional area is selected according to the length of the screen diagonal.

The essence in the range of the method consists in the fact that an individual optical microelement is built of a transparent core and a transparent external shell, where a

refractive index of the external shell is lower than a refractive index of the optical microelement transparent core.

The essence in the range of the method also consists in the fact, that the most convenient are those optical microelements that have the external diameter in range from 0.03 mm to 1.0 mm and the ratio of microelement core thickness to the outer layer of the optical microelement, where the layer is made of the transparent material of lower refractive index equal 6.25 : 1.

The essence of the method is also that the most convenient are optical microelements of the same outer diameters, homogeneously settled on the surface of the screen.

The essence of the invention in the range of the screen is that the screen is made in the form of a transparent material panel which structure enables to obtain a contrastive image on the forward surface without the glare effect, and that the optical microelements are embedded in the screen panel.

The essence of the invention in the range of the screen is also that the surfaces of individual optical elements, which are parallel to both surfaces of the screen, are totally transparent and the spaces between the cores of all optical elements, which make a homogeneous matrix of the screen, are filled with a transparent material of properly lower refractive index, preferably of its lower value with reference to the refractive index of the optical microelement cores. It is the most convenient if the cores of optical microelements making a group fulfilling the whole surface of the screen, which make the homogeneous screen matrix, are made of the same optical material as the rear panel of the screen, on which the image is projected.

The essence of the invention in the range of screen is that the screen structure on its cross section consists of two basic layers, where the rear panel contains optical microelements located perpendicularly, the forward layer is a carrying element that protects optical microelements against mechanic defects, and the fore panel contains antireflective

substances. It is advantageous to combine all the optical elements by means of a transparent element which runs linearly with the reference to the space orientation and which is situated perpendicularly towards the observer.

A profitable result of this invention is the fact, that the image projected by the rear projection and generated on the surface of a new screen is void of all imperfections which characterise systems of optical focusing screens. The most important advantage resulting from applying the invention is a reasonable improvement of the image contrast. The improvement of the image contrast obtained on the surface of the screen where the invention essence was applied is due to the fact that new screens do not cause so significant light loss which are present in the screens with optical focusing screens. The improvement of the optical parameters was obtained by elimination of the turbid surfaces; all surfaces are fully transparent. This feature of the new screens makes the contrast of the image obtained on the screen surface dependable only on the parameters of the image source.

One of the most important advantages obtained due to the use of the new screen for rear projection is the possibility to get a high degree of the image contrast comparable with a conventional image-tube.

So far the screen systems used in TV projectors with the system for rear projection have not expressed the good sharpness of the image shapes, and there has also been a perceivable a lower level of the image contrast. The image projected from the rear position in medium- and widescreen TV projectors with the use of the essence of the invention may be comparable, in respect of quality, with the image of the kinescope of the TV set. Achieving so high quality level of the image with the use of TV projector, it can be supposed that these appliances would have many votaries. A profitable result of the invention essence would be a considerably lower price of this technical solution in comparison to the newly made flat plasma screens, the so called *plasmatrons*, presented among others by *Sony* Co..

Application of the invention essence would have a considerable effect on the growth of interest as far as widescreen technique in the equipment for cinema and TV postproduction is concerned.

An advantageous result of the invention essence would be using it in all kinds of multimedia techniques in advertising and cinema production.

The subject of the invention is shown in **Fig. 1**, which presents a cross-section of the fragment of the screen made of a transparent material, which has a structure according to the essence of the invention; **Fig. 2** presents a cross-section of a single optical microelement made of the transparent plastics which is embedded on the screen surface of the fore panel of the screen made of the transparent material; **Fig.3** presents the top view in section of the screen for rear projection, where the essence of the invention is applied.

The example of the screen made with the use of the invention essence and shown in **Fig. 1**, **Fig. 2**, and **Fig. 3**, consists of the following elements:

1. Rear surface of the screen made of plastics, located in the inner part which is made of transparent material, e.g. polymethacrylate of proper optical features;

2. Transparent cores of optical microelements made of plastics, e.g. polymethacrylate;

3. Fore surface of the screen which is the bearing structure in a form of a panel made of the transparent material;

4. Transparent outer shell of optical element with lower refractive index;

5. Elements in shape of strips vertically positioned on the screen, covering one vertical row of optical elements in relation to the axis of the observer, in purpose to improve horizontal viewing of the image projected on the screen;

6. Joints of two panel surfaces made of transparent material.

The light image is projected by the projector from the rear position through the optical system on the rear surface of the screen 1., then the image falls on the matrix of transparent optical microelement cores 2., positioned perpendicularly to both of the screen surfaces 1.

and 3., optical analysis of the image takes place on the fore surface of the screen 3.; on the fore screen surface 3. a contrast image with no glare is generated; improvement of horizontal viewing is attained through optical elements 5. vertically arranged with the respect to the observer.

Author's Claims

1. The method of image optical analysis in screens for rear projection, in which the light image, generated by the projector, is projected on the rear surface of the screen and the image optical analysis takes place on its fore surfaces, at the same time the light goes through the transparent material of the screen panel which structure makes it possible to obtain a contrastive image on the fore surface without a glare effect. significant by the fact that the generated light image goes through the transparent optical microelements embedded in the screen panel, expediently in the shape of the cylindrical cross-section, which are arranged in such a way that their longitudinal axes are perpendicular to both of the screen surfaces, at the same time the length and a number of the microelements are s selected in dependence on the intensity of the light source and the required resolution and the image contrast; the cross-sectional area of the optical microelements is selected with the respect to screen diagonal length.

2. The method of image optical analysis in screens for rear projection, acc. to Claim No.1, significant by the fact that the light flux generated by the image projector goes through the transparent core of optical microelement surrounded by the transparent outer shell, at the same time it is most advantageous when the refractive index of the outer shell is lower than the refractive index of optical microelement transparent core.

3. The method of image optical analysis in screens for rear projection, acc. to Claim No.1, significant by the fact that the most advantageous is the application of transparent optical microelements of the outer diameter in the range from 0.03 to 1.0 mm and the ratio of the microelement core thickness to the outer layer of the optical microelement made of transparent material of lower refractive index is expressed most advantageously by the ratio 6.25 : 1.

4. The method of image optical analysis in screens for rear projection, acc. to Claim No.1, significant by the fact that that the most advantageous is the application of optical microelements of the same outer diameter, which fulfil homogeneously the surface of the screen.

5. The screen for optical analysis of image for rear projection, in the form of the panel made of transparent material of the structure which enables to obtain contrastive image on the fore surface without a glare effect, significant by the fact that in the screen panel **(1)** optical elements **(2)** are embedded.

6. The screen, acc. to Claim No. 5, significant by the fact that that the surfaces of individual optical microelements **(2)**, which are parallel to both screen surfaces, are fully transparent.

7. The screen, acc. to Claim No. 5, significant by the fact that that the space between the cores of all optical microelements **(2)** which make a homogeneous matrix of the screen, are filled with transparent material **(4)** of the proper refractive index, most advantageously of lower refractive index with the respect to the core of optical microelements **(2)**.

8. The screen, acc. to Claim No. 5, significant by the fact that the cores of optical microelements **(2)** which make a homogeneous screen matrix are the most advantageous when made of the same optical material that the rear panel of the screen **(1)** on which the image is projected.

9. The screen, acc. to Claim No. 5, significant by the fact that the structure of the screen in cross-section advantageously consists of two basic layers, where a rear panel of the screen **(1)** includes optical microelements **(2)** situated perpendicularly, another layer, a fore panel **(3)**, is a bearing element protecting optical microelements **(2)** against mechanic defects and containing antireflective substances.

10. The screen, acc. to Claim No. 5, significant by the fact that it is advantageous to join all optical microelements **(2)** with a transparent element **(5)** running linearly in relation to the assumed space orientation, most advantageously vertical with the respect to the observer.

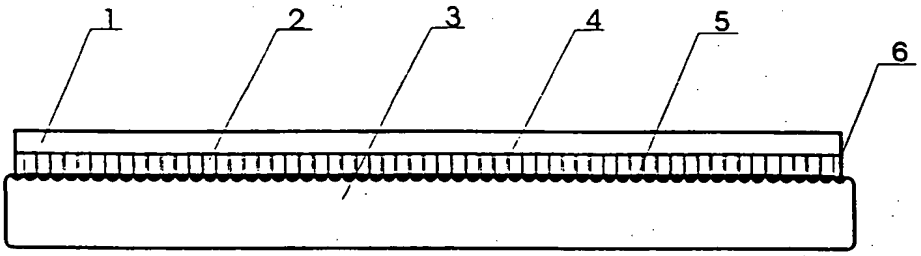

Fig. 1

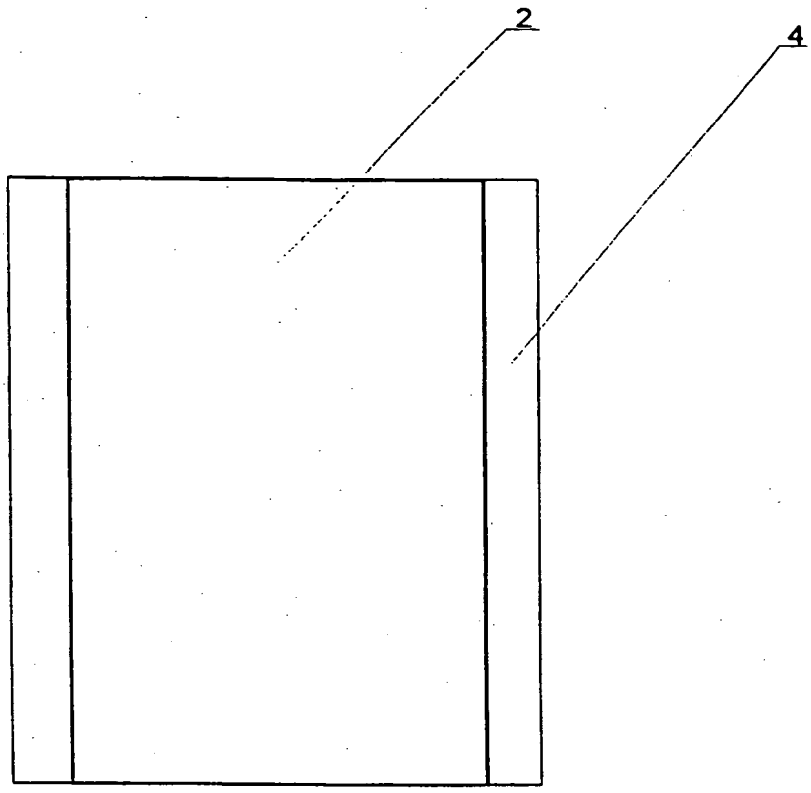

Fig.2

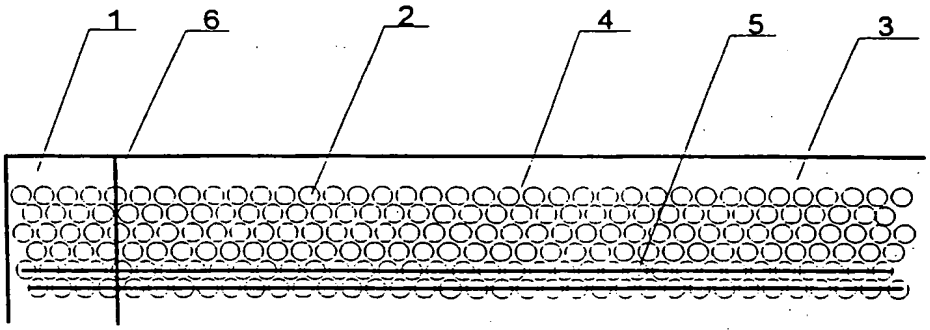

Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N5/72

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N G03B G09F G02F G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 5 543 870 A (BLANCHARD R.) 6 August 1996 see column 5, line 29 - column 6, line 51 ---	1-10
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A	US 5 101 279 A (KUREMATSU K. ET AL) 31 March 1992 see column 2, line 60 - column 6, line 45 ---	1,5,10
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